What is a Sex-Linked Trait?

Worksheet

A sex-linked trait is controlled by a gene on the X or Y chromosome, so its inheritance pattern differs between males (XY) and females (XX) - most sex-linked disorders are X-linked recessive and show up more often in males.

Questions

1. A father is colorblind (X^cY) and the mother has normal vision and is not a carrier (X^CX^C). What fraction of their daughters will be carriers?

A) 0%
B) 50%
C) 100%
D) 25%

2. Which chromosome combination makes a male affected by an X-linked recessive trait with just one copy of the allele?

A) XX
B) XY
C) XXY
D) YY

3. A carrier mother (X^CX^c) and unaffected father (X^CY) have a son. What is the probability the son is affected?

A) 0%
B) 25%
C) 50%
D) 100%

4. Which trait pattern is passed only from father to son?

A) X-linked dominant
B) X-linked recessive
C) Y-linked
D) Autosomal recessive

5. A colorblind man (X^cY) and a homozygous normal-vision woman (X^CX^C) have children. What are the possible genotypes of their daughters and sons?

6. A carrier woman (X^CX^c) and a normal-vision man (X^CY) have a son. What is the probability he is colorblind?

7. Hemophilia (X-linked recessive) affects 1 in 10,000 males in a population. Estimate the carrier frequency among females (Hardy-Weinberg-style q).

8. Define: What is a sex-linked trait?

9. Define: Why are X-linked recessive disorders more common in males?

10. Define: Can a female be a carrier of an X-linked trait?

Answer Key

1. C) 100% - Every daughter gets the father's only X (X^c) and mother's X^C, making all daughters carriers (X^CX^c).

2. B) XY - Males are XY, so they have only one X chromosome - one recessive allele is enough to express the trait.

3. C) 50% - The son always gets Y from dad and either X^C or X^c from mom with 50/50 chance, so 50% probability of being affected.

4. C) Y-linked - Y-linked traits travel only down the male line since only sons inherit the father's Y chromosome.

5. Father contributes X^c or Y. Mother contributes X^C only. Daughters: X^CX^c (all carriers, normal vision) Sons: X^CY (all normal vision)

6. Mother's eggs: 1/2 X^C, 1/2 X^c Father's sperm: 1/2 X^C (daughter), 1/2 Y (son) Sons get Y from father + either X^C or X^c from mother P(colorblind son) = 1/2 (50%)

7. Male frequency = q (X-linked, one allele) = 1/10,000 = 0.0001 Carrier females 2pq 20.0001 = 0.0002 (about 1 in 5,000 women)

8. A trait controlled by a gene on a sex chromosome (X or Y), so it's inherited differently in males and females.

9. Males have only one X chromosome, so a single recessive allele is enough to show the trait - there's no second X to mask it.

10. Yes - a heterozygous female (X^CX^c) carries the recessive allele but usually shows no symptoms because her other X is normal.